FIGURE 1

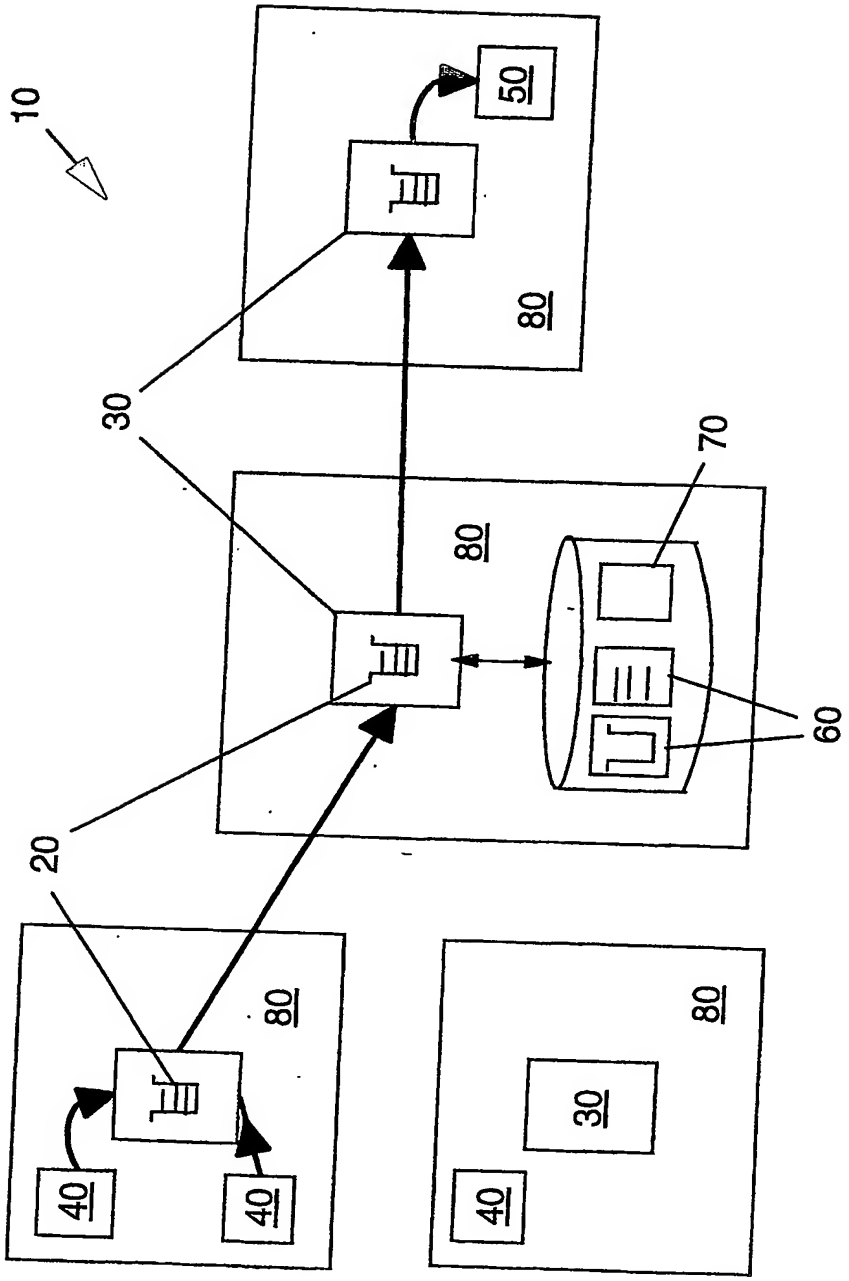


FIGURE 2

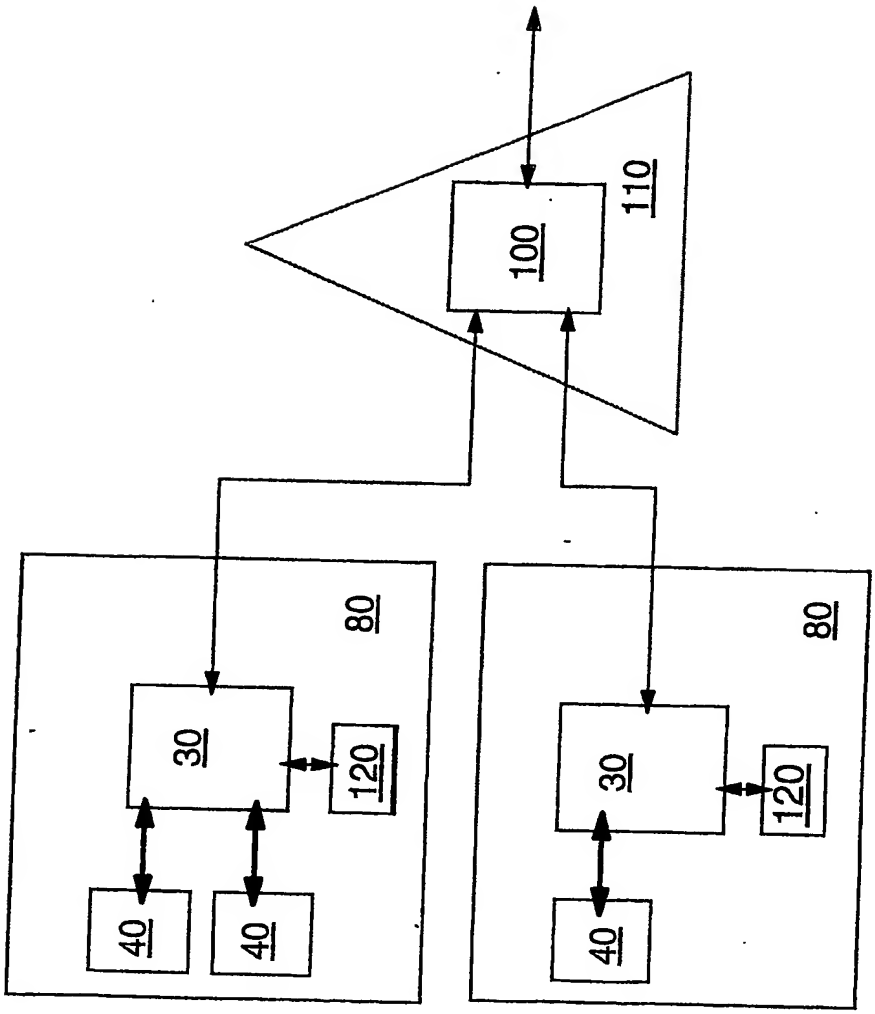


FIGURE 3

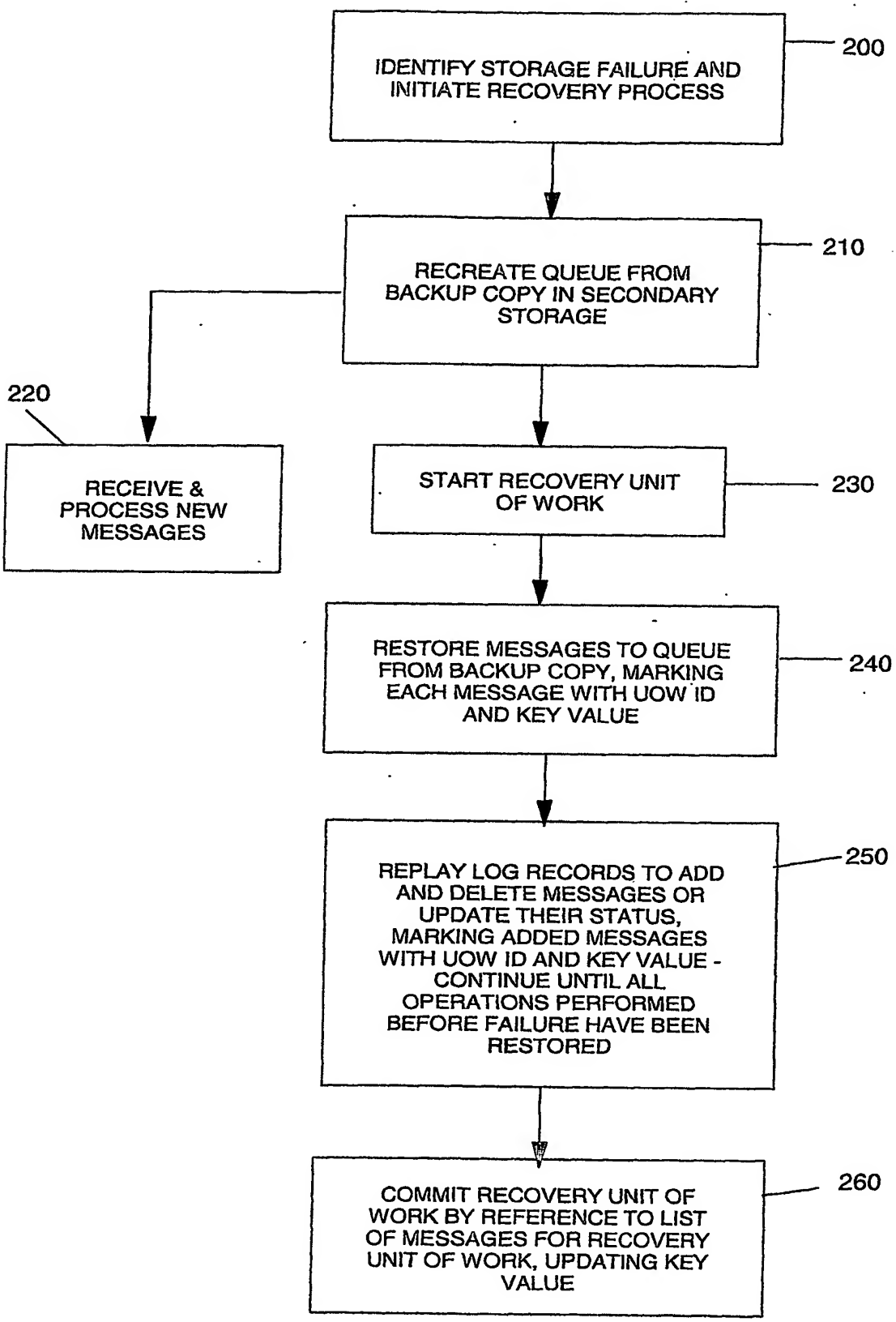

IDENTIFY STORAGE FAILURE AND INITIATE RECOVERY PROCESS
200
RECREATE QUEUE FROM BACKUP COPY IN SECONDARY STORAGE
210
220
RECEIVE & PROCESS NEW MESSAGES
START RECOVERY UNIT OF WORK
230
RESTORE MESSAGES TO QUEUE FROM BACKUP COPY, MARKING EACH MESSAGE WITH UOW ID AND KEY VALUE
240
REPLAY LOG RECORDS TO ADD AND DELETE MESSAGES OR UPDATE THEIR STATUS, MARKING ADDED MESSAGES WITH UOW ID AND KEY VALUE - CONTINUE UNTIL ALL OPERATIONS PERFORMED BEFORE FAILURE HAVE BEEN RESTORED
250
COMMIT RECOVERY UNIT OF WORK BY REFERENCE TO LIST OF MESSAGES FOR RECOVERY UNIT OF WORK, UPDATING KEY VALUE
260

FIGURE 4A

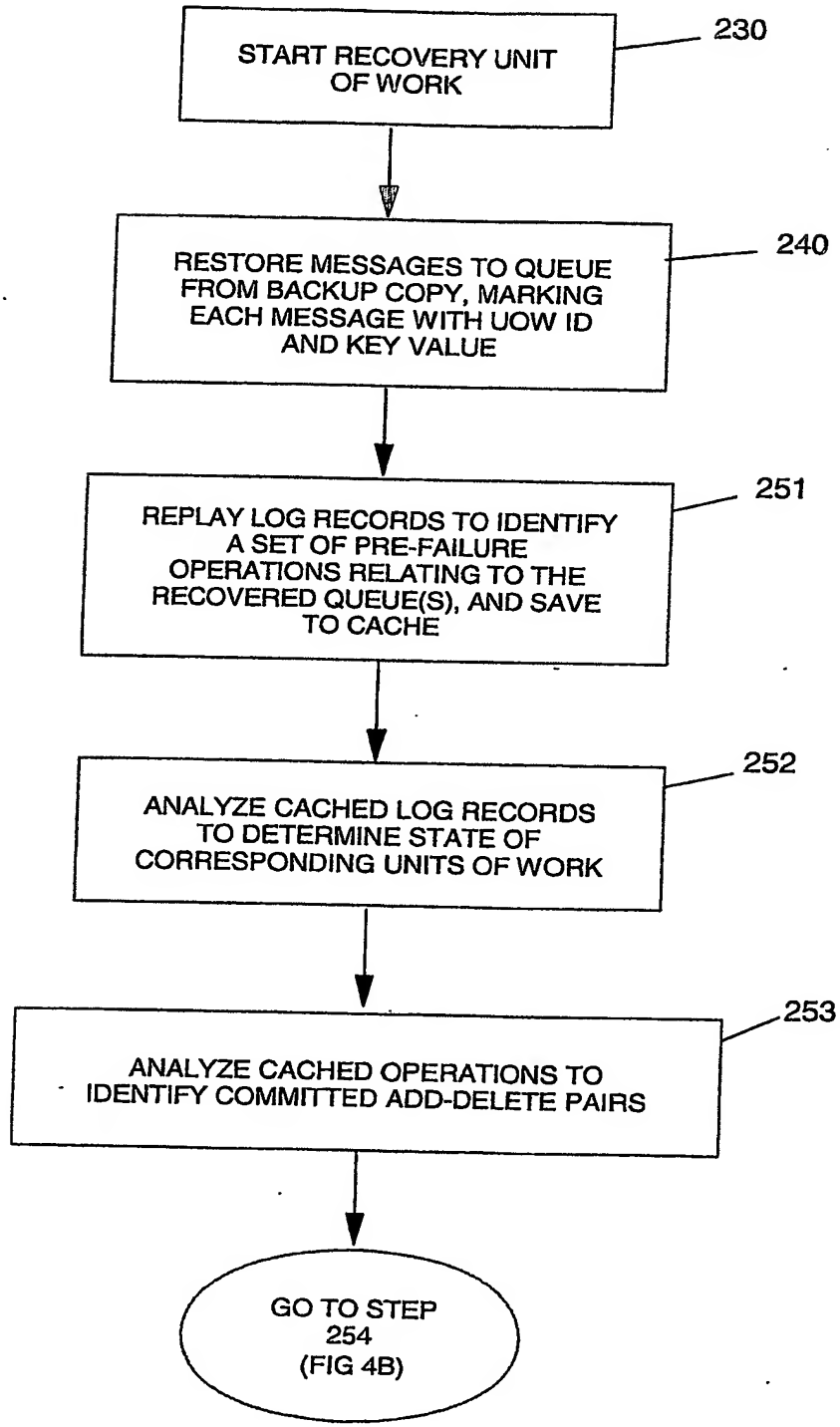
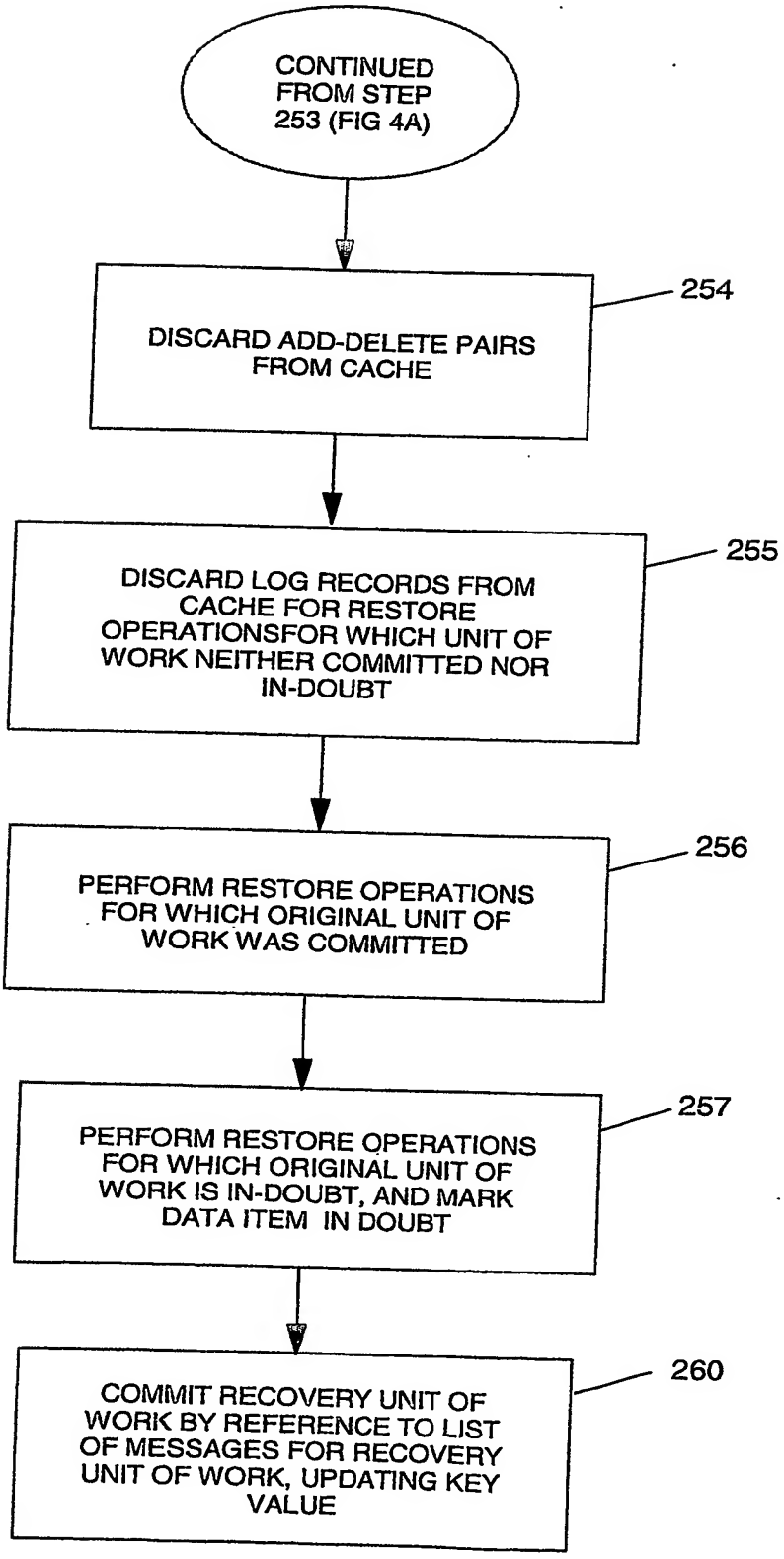

START RECOVERY UNIT OF WORK
230
RESTORE MESSAGES TO QUEUE FROM BACKUP COPY, MARKING EACH MESSAGE WITH UOW ID AND KEY VALUE
240
REPLAY LOG RECORDS TO IDENTIFY A SET OF PRE-FAILURE OPERATIONS RELATING TO THE RECOVERED QUEUE(S), AND SAVE TO CACHE
251
ANALYZE CACHED LOG RECORDS TO DETERMINE STATE OF CORRESPONDING UNITS OF WORK
252
ANALYZE CACHED OPERATIONS TO IDENTIFY COMMITTED ADD-DELETE PAIRS
253
GO TO STEP 254 (FIG 4B)

FIGURE 4B


CONTINUED FROM STEP 253 (FIG 4A)
DISCARD ADD-DELETE PAIRS FROM CACHE
254
DISCARD LOG RECORDS FROM CACHE FOR RESTORE OPERATIONSFOR WHICH UNIT OF WORK NEITHER COMMITTED NOR IN-DOUBT
255
PERFORM RESTORE OPERATIONS FOR WHICH ORIGINAL UNIT OF WORK WAS COMMITTED
256
PERFORM RESTORE OPERATIONS FOR WHICH ORIGINAL UNIT OF WORK IS IN-DOUBT, AND MARK DATA ITEM IN DOUBT
257
COMMIT RECOVERY UNIT OF WORK BY REFERENCE TO LIST OF MESSAGES FOR RECOVERY UNIT OF WORK, UPDATING KEY VALUE
260